

DGPs Preconference Workshop 2018



Multinomial Processing Tree (MPT) Modeling: Basic Methods and Recent Advances

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2) Applications I

- 2.1) Introduction to multiTree
- 2.2) Practical exercises
- 2.3) Order constraints
- 2.4) Testing interactions

2.1) Introduction to multiTree

multiTree v0.45 - untitled

Parameters Data Equations Output

Usage:

- 1) Enter or import equations. Save file to check validity of the equations.
- 2) Enter or import data. Save again to validate.
- 3) Review model specification.
- 4) Run analysis.

Output

- ☒ Standard Errors
- ☒ 95 % Confidence Intervals
- ☐ Minimum Description Length
- ☐ Plot
- ☐ Specification
- ☐ Moments
- ☐ Information Matrix
- ☐ Jacobian
- ☐ Iteration History

EM Algorithm

- ☒ Random Start Values
- Replications: 2
- Convergence: $1.0E-10$
- Max Iterations: 5000
- λ : 0
- ϵ : 1
- Frequency constant: 0
- Zero Probabilities: 0
- Boundary Parameters: $1.0E-8$

Bootstrapped Model Fit

- ☐ Bootstrapped p-Value
- Number of Samples: 500

Reset to Defaults

Welcome to multiTree v0.45

Storage-Retrieval Model

(Batchelder & Riefer, 1980, 1986)

The screenshot shows the multiTree v0.45 software interface. The main window is titled "Ohne Titel — Bearbeitet" and the file name is "multiTree v0.45 - StorageRetrievalAging1Group.mpt". The interface has a menu bar with "Parameters", "Data", "Equations", and "Output". The "Equations" tab is selected, showing a list of equations:

```

1 1 c*r
1 4 c*(1-r)
1 2 (1-c)*u*u
1 3 (1-c)*u*(1-u)
1 3 (1-c)*(1-u)*u
1 4 (1-c)*(1-u)*(1-u)
2 5 a
2 6 (1-a)

```

On the right side, there are several configuration panels:

- Output:**
 - ☒ Standard Errors
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 - ☐ Information Matrix
 - ☐ Jacobian
 - ☐ Iteration History
- EM Algorithm:**
 - ☒ Random Start Values
 - Replications: 2
 - Convergence: 1.0E-10
 - Max Iterations: 5000
 - λ : 0.0
 - ϵ : 1.0
 - Frequency constant: 0.0
 - Zero Probabilities: 0.0
 - Boundary Parameters: 1.0E-8
- Bootstrapped Model Fit:**
 - ☐ Bootstrapped p-Value
 - Number of Samples: 500

At the bottom, there is a status bar with a log of recent events:

```

[14:11] Running power analysis... target ncp = 7.84886 current ncp = 7.84886
[14:11] Power analysis finished.
[14:13] Opened file: /Users/edgarerdfelder/Desktop/Basel Workshop/MedianTest.mpt
[14:15] Opened file: /Users/edgarerdfelder/Desktop/Basel Workshop/2-Class-LCA.mpt
[14:16] Opened file: /Users/edgarerdfelder/Desktop/Basel Workshop/EA Aging Analysis/StorageRetrievalAging1Group.mpt

```

Data

multiTree v0.46 - StorageRetrievalAging1Group.mpt

Parameters Data Equations Output

Data Type: Category Frequencies Analyze Set 1 Daten von Ute E

Daten von Ute Bayen (1990), jung (lag 0), dg 1

1	90
2	14
3	84
4	212
5	102
6	298

Set 1 Set 2 Add new data set

Output

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Bootstrapped Model Fit

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Welcome to multiTree v0.46

[19:37] Opened file: /Users/edgarerdfelder/Desktop/multiTree files/StorageRetrievalAging1Group.mpt

Model definition and analysis

multiTree v0.46 - StorageRetrievalAging1Group.mpt

Parameters Data Equations Output

Hierarchical Model Families

☐ Define current model as new baseline model (needs to be estimated before it can serve as a baseline).

☐ Compare current model against baseline model

a = u 0.25431

c free 0.44815

r free 0.50206

u free 0.25431

Specification

Number of trees	2
Number of categories	6
Number of free categories	4
Number of parameters	4
Number of constrained parameters	1
Degrees of freedom	1

Output

☒ Standard Errors

☒ 95 % Confidence Intervals

☐ Minimum Description Length

☐ Plot

☐ Specification

☐ Moments

☐ Information Matrix

☐ Jacobian

☐ Iteration History

EM Algorithm

☒ Random Start Values

Replications 2

Convergence 1.0E-10

Max Iterations 5000

λ 0.0

ϵ 1.0

Frequency constant 0.0

Zero Probabilities 0.0

Boundary Parameters 1.0E-8

Bootstrapped Model Fit

☐ Bootstrapped p-Value

Number of Samples 500

Reset to Defaults

Welcome to multiTree v0.46

[19:37] Opened file: /Users/edgarerdfelder/Desktop/multiTree files/StorageRetrievalAging1Group.mpt

Output

multiTree v0.46 - StorageRetrievalAging1Group.mpt

Parameters Data Equations Output

File: /Users/edgarendfelder/Desktop/multiTree files/StorageRetrievalAging1Group.mpt
Data Set 1: Daten von Ute Bayen (1990), jung (lag 0), dg 1

Estimation proceeded normally.

Model Fit

PD^{lambda}=0.0 (df=1) = 0.00731 p = 0.93188

ln(likelihood) = -673.97963
AIC = 1353.95926
BIC = 1368.01310
Delta AIC = -1.99269
Delta BIC = -6.67731

Parameter Estimates, Standard Errors, and Confidence Intervals

a	=	u		
c	=	0.44813	(0.06124)	[0.32811 - 0.56816]
r	=	0.50209	(0.07298)	[0.35905 - 0.64512]
u	=	0.25431	(0.02021)	[0.21470 - 0.29392]

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Bootstrapped Model Fit

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Number of Samples: 500

Reset to Defaults

[19:48] Estimation #2
[19:48] Estimation #3: Iteration 100...converged
[19:48] Estimation #2: Iteration 105...converged
[19:48] Estimation #1: Iteration 105...converged
[19:48] Analysis finished

2.2) Practical exercises

- Estimate the storage-retrieval model for young and old participants jointly
- Does c differ significantly between age groups?
- Does r differ significantly between age groups?

2.3 Order constraints

- To impose the order constraint
 $c(\text{old}) \leq c(\text{young})$,
set
 $c(\text{old}) = x_c \cdot c(\text{young})$

2.4 Testing interactions

- To test the H_0 that the decline with aging is the same in *storage* c and *retrieval* r (i.e, no interaction with aging)

set

$$c(\text{old}) = x_c \cdot c(\text{young})$$

$$r(\text{old}) = x_r \cdot r(\text{young})$$

and test the equality constraint

$$H_0: x_c = x_r$$